OBJECTIVES

- **A** Describe rift eruptions and features associated with them, and tell where they occur.
- **B** Discuss and give examples of subduction zone eruptions, and discuss the features that occur there.
- **C** Discuss the occurrence of hot spots and the features associated with them.

II Kinds of Eruptions

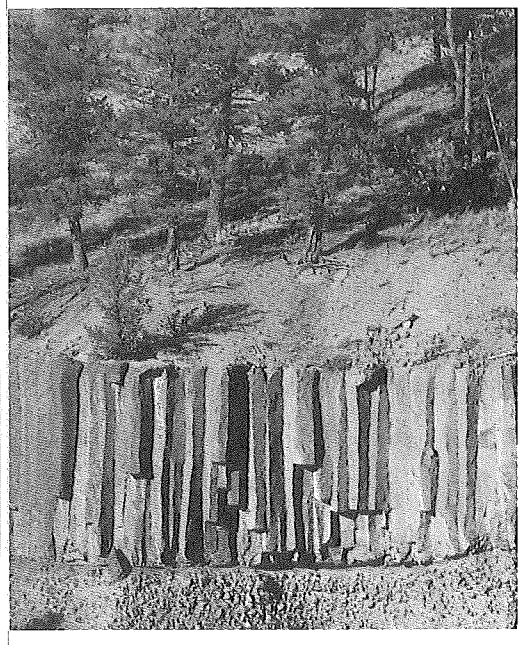
Topic 5 Rift Eruptions

Rift eruptions occur at long, narrow fractures in the crust. These fractures may be on the ocean floor or on land. Rift eruptions typically flow out smoothly and fluidly because the lava is basaltic and contains few gases. In some cases layers of lavas build *shield cones.* A shield cone is a volcanic mountain with a broad base and gently sloping sides (Figure 14.3(a)).

Rift eruptions in the oceans occur at spreading centers, such as the mid-Atlantic Ridge and the East Pacific Rise. The lava oozes out and cools rapidly into rounded shapes called *pillow lavas.*

Rift eruptions on land may spread lava evenly over thousands of square kilometers. Lavas from the East African Rift system have covered large areas with basalt, forming a *basalt plateau.* The Columbia Plateau of Washington, Oregon, and Idaho is another example of a basalt plateau. During the past 50 million years, lava from rift eruptions has covered an area of over 200 000 square kilometers with up to 1500 meters of basalt. Other examples are the Karroo Plateau of South Africa, and the Parana Plateau of South America.

When the basalt of plateaus and other thick lava flows on land cool, they may display a unique pattern of closely packed, six-sided columns called *columnar jointing.* These columns are thought to form as cooling lava shrinks and cracks. The columns are as high as the thickness of the basalt flows.



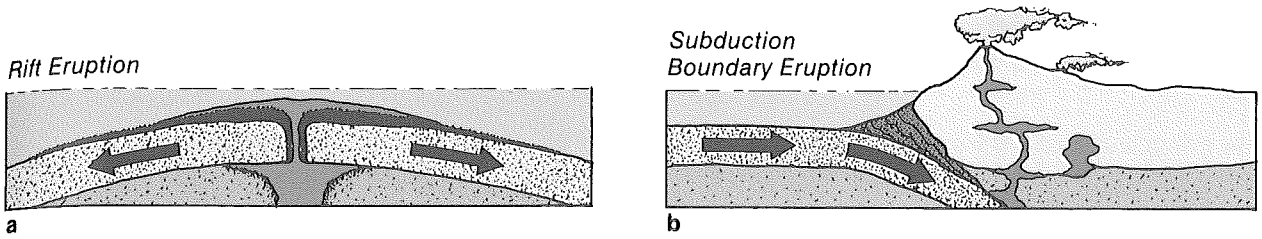
14.5 Columnar jointing is clearly visible in this basaltic sill.

Topic 6 Subduction Boundary Eruptions

Subduction boundary eruptions are the result of magma that forms at subduction boundaries (Chapter 13, Topic 11). Unlike the magma that forms at rifts, this magma tends to be thick and to contain large amounts of gases. As a result, subduction boundary eruptions usually are explosive, and the erupted material is mostly lava fragments (tephra). The volcanic cone that forms usually has very steep sides and is called a *cinder cone* (Figure 14.3(b)).

Most of the world's active volcanoes occur at subduction boundary eruptions. Many form the island chains that are typical of the west side of the Pacific Ocean. The most active volcanic chain is the islands of Indonesia. Other examples of volcanic chains resulting from subduction boundary eruptions are the Philippine Islands, the islands of Japan, and the Aleutian Islands off Alaska.

Subduction boundary volcanoes are also associated with young mountain ranges. The Cascades of Washington and Oregon, the mountains of Central America, and the Andes of South America all have active or recently active volcanoes.



14.6 **(a)** Huge amounts of lava flow smoothly from a rift eruption, covering large areas with basalt. **(b)** Subduction boundary eruptions are usually more explosive.

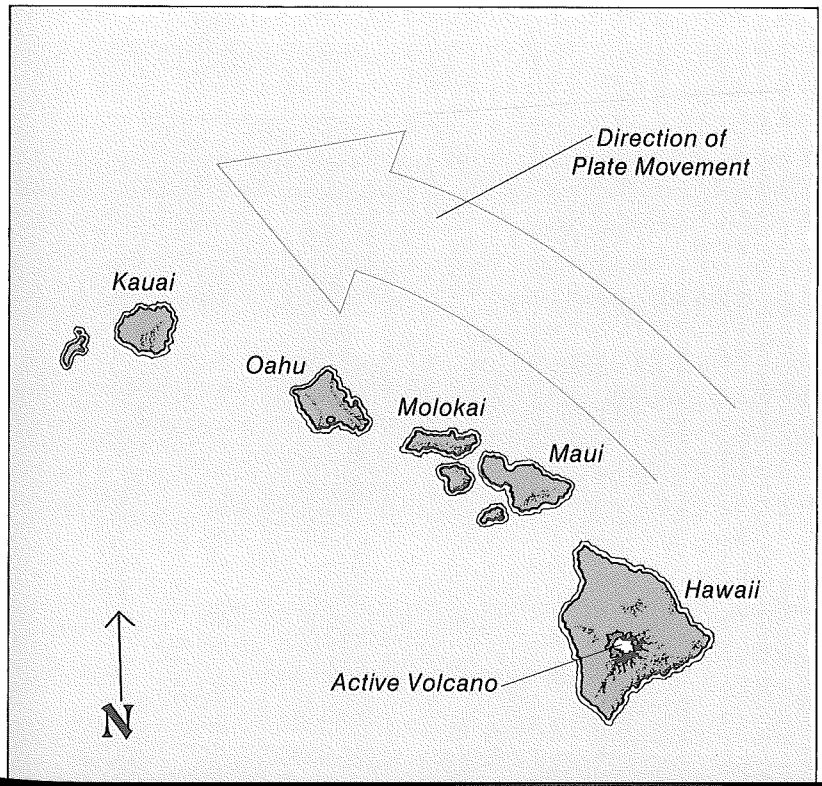
Topic 7 Hot Spots

Not all volcanism occurs at plate boundaries. **Hot spots** are areas of volcanic activity in the middle of lithospheric plates.

The lava erupted at hot spots is similar to that of rift eruptions—it usually flows smoothly over the surface. However, unlike the lava that wells up at rifts, hot spot lavas form cones. These shield cones are usually broad and have gently sloping sides.

The cause of hot spots is not clear, although some kind of concentration of heat from radioactive sources in the asthenosphere is suspected. The hot spot seems to remain in the same location even though the lithospheric plate above it moves. The result is a chain of extinct volcanoes marking former positions of the plate over the hot spot.

The most famous example of hot spot volcanism is the Hawaiian Islands. The island of Hawaii has active volcanoes and is now directly over the hot spot. To the northwest is a chain of extinct volcanic islands (Figure 14.7). The age of the rocks that form each island is increasingly older away from Hawaii. This indicates a steady movement of the Pacific Plate over the hot spot.



14.7 A chain of extinct volcanoes marks the movement of a lithospheric plate over a hot spot.

TOPIC QUESTIONS

Each topic question refers to the topic of the same number.

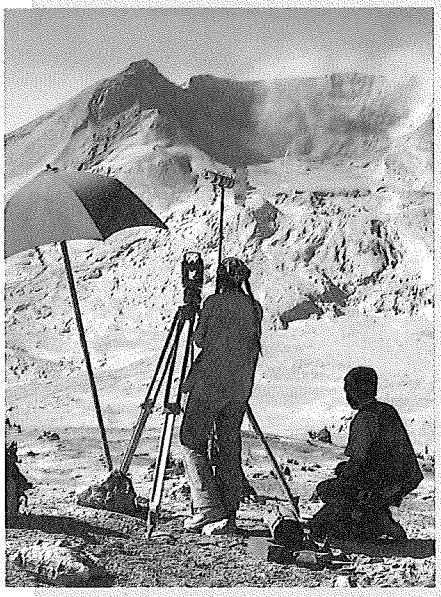
5. **(a)** Where do rift eruptions occur? **(b)** How does lava behave at rift eruptions? **(c)** Name two locations where rift eruptions occur in the ocean. **(d)** Give one example of a rift eruption on land. **(e)** What is a basalt plateau? Give some examples. **(f)** What is columnar jointing?

6. **(a)** How are subduction boundary eruptions different from rift eruptions? What causes the difference? **(b)** What is the shape of the volcanic cone that forms at subduction boundaries? **(c)** Name two landform features that form at subduction boundaries and give one example of each.

7. **(a)** What are hot spots? **(b)** How does lava behave at hot spots? **(c)** What is the shape of the volcanic cone that results? **(d)** What is thought to be the cause of hot spots? **(e)** How does the lithosphere behave relative to a hot spot? **(f)** How do the Hawaiian Islands support your answer to **(e)**?

Current RESEARCH

Volcanoes: One Eye on the Giant



Think of a volcano as a sleeping giant. There are over 1300 volcanoes known to have erupted in the last 12 000 years. Recent activity is no indication of a volcano's potential for destruction. A volcano can be inactive for centuries and then suddenly erupt, seemingly without warning. Predicting when a volcano will erupt could save thousands of lives.

In the past, volcanologists monitored changes in a volcano's slope or height, looking for bulges that might indicate a magma buildup. Another warning sign is the increase in the number of small earthquakes beneath the volcano caused by magma moving upward.

New techniques are being used to predict eruptions. In the 1980s, infrared *Landsat* photos revealed a hot spot beneath a volcano in the Andes Mountains of Chile shortly before an eruption. Satellites are also used to measure changes in a volcano's elevation, which may indicate a pre-eruption bulge.

Monitoring volcanoes can be risky. Japan's Mount Unzen had been inactive since 1792 when it started to rumble with earthquakes in 1990. Scientists gathered at the volcano, hoping to predict a catastrophic eruption and warn the 200 000 people living around Mount Unzen. When part of the volcano collapsed on June 3, 1991, thirty-seven people, including three volcanologists, died when a rapidly flowing cloud of hot ash descended on the town of Kamikoba.